PHARO Maintenance and Operation Notes - 2
by T. Hayward, 2002 Jan 29

Introduction

PHARO was removed from the AO bench and opened for servicing 2002 January 23-26 by T. Hayward and R. Burruss. The primary goals for the servicing were to investigate the positioning problems recently experienced with the Grism wheel and Carousel, to install several new, higher quality filters, and to determine why the shutter was inoperative.

Grism Wheel

The grism wheel had been observed to stop between two filter positions in a way that suggested an occasional large backlash, as if the drive gear was loose on its shaft.

Upon inspection, we found that all the grism wheel gears and couplings were tight. The spur and main gears were clean and in excellent condition with only very slight wear marks visible on the main gear. We removed the stepper motor and observed no irregularities in its motion when run by itself. With the motor reconnected, we observed a slight roughness in the motion of the grism wheel. After backing the spur gear away from the main gear very slightly, the wheel appeared to turn more smoothly.

We also observed occasional position errors in the main wheel of about 1 tooth in amplitude after moving between filters two or three positions apart (there are 400 teeth on the main gear, and 1 tooth corresponds to 10 motor half-steps). We could not determine the cause of these errors.

One theory for the large position errors is that, since the grism wheel is not balanced due to the assymetrical placement of grisms and filters, the wheel is turning after the end of a move (when the stepper motor drive and hold currents are turned off). However, this should produce a steady drift in the wheel at certain positions, a symptom which has never been reported: the natural friction in the gears and stepper motor appears to be sufficient to hold the wheel in place.

Because we could identify no clear cause of the positioning problem, we reassembled the grism wheel as it was, with the same motor. We did make the slight adjustment to the spur gear separation. We will continue to observe the grism wheel's performance to see if further errors appear. There is a spare cryogenic motor in the PHARO cabinet at Palomar, but installing it requires disconnecting and resoldering 4 drive current wires at a connector inside the dewar.

Addendum Jan 31: After PHARO was cooled and mounted on the telescope for two days, R.B. noticed an error in the grism wheel position after a number of moves during the AO setup. We tried reproducing the error for an hour or two

but could not. We then increased the grism motor drive current, turning the pot in the controller clockwise by about 1/10 revolution. No errors occurred in several hours observing that night; which is encouraging. However, the grism wheel still should be monitored closely by Palomar staff and observers, especially when making critical observations, until its reliability can be better determined.

Shutter

The shutter has been inoperative for more than a year: no motion of the stepper motor can be detected with the dewar cold.

With the dewar warm and open, we could drive the shutter motor back and forth, but the motion was erratic: a command of a certain number of steps would sometimes execute properly, but sometimes the motor would move by the wrong number of steps, probably due to hysteresis.

We did not have time to fully diagnose and solve this problem, so we removed the shutter blade from the motor so that inadvertent commands will not leave the shutter closed.

Carousel and other mechanisms

We also inspected the carousel and all other moving mechanisms. All components appeared to be in nearly new condition and operated smoothly. We found no gears or couplings that were loose on their shafts. The carousel limit switches were properly aligned with the actuator tab on the main wheel and functioned normally.

Filters

We successfully installed five new high-quality filters manufactured for the AO filter consortium by NDC. The new filters are: CH_4 Long 1.690, Br-γ 2.166, K_{cont} 2.270, [Fe II] 1.65, and H_2 v=1-0 S(1) 2.122. The Br–γ, K_{cont}, and [Fe II] filters replaced lower quality versions of the filters that were already in PHARO.

To make room for the new filters, the K' and Pa-β filters were removed. K' has a bandpass optimized for Mauna Kea; PHARO still has a K_s filter which is more suitable for Palomar's lower elevation.

Unfortunately, we did not receive the CH_4 Short filter in time to install it in PHARO for this run. We now have the filter, so we will determine what the best opportunity is to install it.